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Heat Extraction through Structural Components of the CMS Phase II Tracker Forward Pixel Detector

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The CMS Inner Tracker Forward Pixel detector will be rebuilt for the instantaneous luminosity of $5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ and up to 200 pp collisions at the High Luminosity LHC. To limit particle occupancy to the per mille level and improve track resolution, we will increase the granularity of the sensors. This will result in power dissipation of approximately 60 kW. For sensors to survive the radiation close to the beam pipe, we will need to maintain them around -20 C. Thus, cooling the detector will be of paramount importance and some structural components will also serve to extract heat.

In particular, the structural materials will include carbon foam, graphite-doped carbon fiber cured at high pressures, and diamond-doped greases and adhesives. We will present thermal conductivity measurements of these materials conducted using custom-apparatus, both before and after 1.5 Grad of radiation, and demonstrate why they are our materials of choice to mitigate thermal runaway.

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